

The University of Chicago

THE CEPHALOPOD FAUNA OF THE  
BUCKHORN ASPHALT

A PART OF A DISSERTATION SUBMITTED TO  
THE FACULTY OF THE DIVISION OF THE  
PHYSICAL SCIENCES IN CANDIDACY FOR  
THE DEGREE OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF GEOLOGY AND PALEONTOLOGY

1935

By

HOMER JAMES SMITH

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# THE CEPHALOPOD FAUNA OF THE BUCKHORN ASPHALT

HOMER J. SMITH

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**Abstract:** The Buckhorn asphalt of southern Oklahoma is Kansas City in age. Its fauna is almost entirely cephalopodan, and Orthoceras is the dominant genus. Two new genera, fifteen new species, and two new varieties are proposed.

## INTRODUCTION

The Buckhorn asphalt occurs as a small outcrop in an abandoned quarry located in Sect. 2, Town. 1 South, Range 3 East, about three miles south of the town of Sulphur, Oklahoma. So far as is known this is the only exposure of this interesting formation. The first mention of the Buckhorn asphalt that the writer has been able to find is by Eldridge (1901, p.295) who gives a detailed description of the pit and the beds and comments on the abundance of nacreous shells. He (ibid, p.292) ascribed the beds to the "lower Coal Measures." Taff (1903) has described the topography and stratigraphy of the general region.

The writer is especially indebted to Dr. Carey Croneis of the Department of Geology and Paleontology, University of Chicago, for collection of material and helpful criticism in the preparation of this paper. Thanks are also due to the Oklahoma Geological Survey and to C.N. Gould, former director, for additional material.

## GENERAL DESCRIPTION OF THE FAUNA

The comminuted fragments of nacreous shells and a thin veneer of clacium carbonate gives the surfaces of the rocks of the pit a white appearance that is very deceptive. When broken the black color of the rocks shows up in startling contrast (although the streak is brown). There is some variation in the color of the different beds, depending upon the degree of impregnation with asphaltum. The main fossil bearing bed, No. 9 of Eldridge's section (1901, p.283), a shaly limestone, is heavily impregnated and consequently very black. This bed is one of the most fossiliferous that the writer has ever seen.

Certainly at the time of the deposition of the more fossiliferous beds of the Buckhorn formation (centering around and

largely consisting of No. 9) the site was one of a most abundant fauna. At least 90 per cent of the fossils (with the exception of the doubtful pelecypod evidence) are cephalopods. The most common form, as we read the rock record, was of a nautiloidean character. This unusual aspect for a Pennsylvanian fauna is rendered startling by the fact that most of this nautiloidean assemblage consists of members of the genus Orthoceras, a form generally poorly represented in rocks of this age. These straight forms, which are mostly of small size, were apparently the dominant form of the time. It is possible, but not probable, that they were exceeded numerically by the pelecypods, but with one exception these latter were of such small size and had such thin shells that their fossil record is very obscure. Probably the gastropods came next in abundance. They are well represented in the fossil state by a number of common forms of rather uniform, moderate size, and are generally rather well preserved. Some of the specimens of Naticopsis display color banding. Next in abundance came the ammonoids, and following these, the coiled nautiloids. The brachiopod record is very poor--the "Productid Seas" did not live up to their character in the case of the Buckhorn deposit. Only a single species of Spirifer was collected, and the few specimens are poorly preserved. The echinoderms are represented only by a few crinoid columnals, and no record was found of the Protozoa, Porifera, Coelenterata, or Arthropoda.

Vertebrate remains are not lacking. Fragments of ganoid fish scales are common throughout the deposit, and a few Cladodus type teeth and a fragment of poorly preserved bone (amphibian?) were collected. It is possible that an exhaustive search would yield some interesting vertebrate fossils.

The remaining record is made up of fossil wood, some of which has formed coal. Although abundant, it is generally rather poorly preserved.

Most of the fossils of the deposit are fragmental; the very abundance of fossils is a factor against complete preservation as fossil abuts against fossil and the result is a profusion of more or less fragmentary material. Then too, the outcrop is so small and so recently exposed that the fossils have not had time to weather out from the surrounding rock. The fossils have to be chiseled out of their matrix, where possible, and commonly are injured in the process of extraction. However, the exceptionally good preservation of the fragments brings to light many of the finer details of surface sculpture that are lost in the ordinary courses of fossilization. The writer has, consequently, been enabled to add a little to the descriptions of preexistent species,



although most of the Buckhorn species are new.

#### AGE OF THE BUCKHORN ASPHALT

The region of the Buckhorn asphalt outcrop is situated on the northern flank of the Ardmore Basin where the structure is very complex and the age of many of the formations is in doubt. Mention has already been made (p.1) of Eldridge's ascribing the beds to the lower Coal Measures. The writer's investigation of the fauna was begun for the purpose of determining, if possible, a more specific age. As the work progressed and the unusual features of the faunal assemblage were more and more revealed this extrinsic object was relegated to a subordinate position and was superceded by interest in the study and development of an intrinsically important fauna. The chief interest of the writer is centered upon the cephalopods of the deposit, which are described in the following part of this paper, the remaining forms being merely listed. For more complete information regarding these forms other than the cephalopods the reader is referred to the writer's thesis, "The Fauna of the Buckhorn Asphalt," University of Chicago (1935).

The study of the fauna of the formation has led the writer to a conclusion that is in general accord, at least, with that previously given: i.e., the Buckhorn asphalt belongs to the Pennsylvanian system and is probably Kansas City in age.

#### LIST OF FOSSILS OTHER THAN CEPHALOPODS

Mention has already been made of the paucity of fossils other than cephalopods. The following is a list of these forms:

Spirifer opimus Hall

Edmondia sp.

Yoldia glabra Beede and Rogers?

Posidonia buckhornensis, n.sp.

Plagiostoma ? acosta (Cox)

Bellerophon sp.

Euphemis carbonarius (Cox)

Euphemis nodocarinatus (Hall)

Straparollus sp.

Naticopsis ventricosa (Norwood and Pratten)

Trachydoma nodosum (Meek and Worthen)

Trachydoma cf. sayrei Knight

## DESCRIPTION OF THE CEPHALOPODS

## I. THE NAUTILOIDEA

The nautiloidean cephalopods of the Buckhorn form an assemblage that is extremely interesting both in number and in variety. Unfortunately, they are generally fragmental, and the writer has been obliged to describe new species from incomplete specimens. Objection may be raised against the establishment of new species on such fragmental material, but the very nature and preservation of the Buckhorn fossils makes this course necessary. Even more regrettable is the fact that the preservation is such that the position of the siphuncle, so important in the classification of the Nautiloidea, cannot usually be determined. Nine genera and seventeen species are described, of which eight new species and one new variety are proposed by the writer.

The nautiloids of the Buckhorn fauna are listed below:

- Pseudorthoceras knoxense (McChesney)
- Dolorthoceras n.sp.
- Dolorthoceras oklahomense, n.sp.
- Orthoceras unicamera, n.sp.
- Orthoceras gracile, n.sp.
- Orthoceras indianum var. buckhornense, var.nov.
- Orthoceras tricamerae, n.sp.
- Ephippioceras ferratum (Cox)
- Temnocheilus milleri, n.sp.
- Metacoceras sp.
- Domatoceras robustum, n.sp.
- Domatoceras buckhornense, n.sp.
- Domatoceras parallelum, n.sp.
- Domatoceras angularum, n.sp.
- Domatoceras angularum var. modestum, n.sp.
- Pseudometacoceras ? sp.
- Solenochilus ? sp.

## Description of the Genera and Species

## Order NAUTILOIDEA Zittel 1884

## Suborder CYRTOCHOANITES Hyatt 1900

## Family SACTOCERATIDAE Troedsson 1926

Genus Pseudorthoceras Girty 1911

The genus Pseudorthoceras was established by Girty (1911, p.143). An excellent summary and description of the genus has recently been given by Miller, Dunbar, and Condra (1933, pp.77-81) to which the reader is referred. The only information that the writer has to add to the generic description is regarding the



surface ornamentation. In most descriptions it is stated that the surface is smooth, although Girty (1916) described two pyritized specimens from the Des Moines group which showed the extreme apical portion to be finely reticulate. One of the writer's specimens has a small portion of the original shell preserved; this clearly displays fine transverse growth lines and slightly more prominent longitudinal lirae, giving a net work appearance.

Pseudorthoceras knoxense (McChesney)

Plate I, figs. 10-12

1860. Orthoceras knoxensis McChesney, Descriptions of new species of fossils, p. 69, (1859).

1933. Pseudorthoceras knoxense Miller, Dunbar, and Condra, Nebraska Geol. Survey Bull. 9, 2nd ser., pp. 81-85, pl. 1.

Orthoceraconic; circular section; moderate size. Regular expansion orad; apical angle of a typical specimen 6.5 degrees. Sutures straight and directly transverse to the long axis of the conch; septa moderately convex apical; about three camerae per diameter (this differs in different specimens and even in different portions of the same specimen). No tips were observed, but the extreme apical portion of this species is slightly curved. Siphuncle central; small in its passage through the septa, but its segments are greatly expanded within the camerae; shape from fusiform apical to subspherical orad; septal necks short and recurved.

The walls of the camerae are lined internally by lamellar deposits which extend from the walls toward the center of the conch along the orad, or concave surface, of the septa. These deposits, which are generic markers, vary in thickness in different specimens and in different parts of the same specimen; they are generally thicker ventrally and adorally.

The outer shell is not preserved on most of the writer's specimens, although several individuals display the smooth inner shell. A very small portion of the outer shell is preserved on one specimen, however; this shows the surface to be marked by fine transverse growth lines showing the presence of a hyponomic sinus, and by slightly more prominent longitudinal lirae, giving a net work appearance. In most descriptions it is stated that the surface is smooth, although Girty (1916) described two pyritized specimens from the Des Moines group which showed the extreme apical portion to be finely reticulate.

Remarks-. It is possible that a new species of Pseudorthoceras should be established for the Buckhorn specimens on the basis of surface sculpture. However, the shell wall is very fragile, and from the rather large number of individuals collected

only one had any portion of the shell surface preserved; all the others had lost their shell, or only the smooth inner shell was preserved. Considering the unusually good preservation of the Buckhorn fossils, the writer thinks it best to place his specimens under Pseudorthoceras knoxense (McChesney), a somewhat all embracing species, and to consider the data on the surface markings as additional information on that species.

Genus Dolorthoceras Miller 1931

This genus was established by Miller (1931, p.419) and the reader is referred to his work for the generic description. The writer is able to add a little to the generic description, as will be noted in the description of Dolorthoceras oklahomense, n.sp. Miller restricted this genus to forms "devoid of ornamentation other than the transverse growth lines." The above species bears, in addition, extremely fine longitudinal striae, hardly visible to the naked eye.

Dolorthoceras n.sp.

Plate I, figs. 13-14

Orthoceraconic, circular in cross section, and of moderate size, the only specimen having a diameter of 21 mm. orad. Conch shows very gradual expansion orad. Sutures straight and directly transverse to the long axis of the conch; septa simple saucer shaped discs moderately convex apicad; there are about 2 1/2 camerae per diameter. Surface of shell unknown; the inner shell and internal cast at least are smooth. The siphuncle is subcentral, quite small in its passage through the septa, but expanded within the camerae; segments subcylindrical in shape but contracted abruptly for passage through the septa.

Remarks-. This form is represented by a single specimen consisting of three camerae, one of which has been cross sectioned. It does not agree with any previously described species of this genus, but the writer feels that too little information is available to establish the new species.

Dolorthoceras oklahomense, n.sp.

Plate I, figs. 15,16

Orthoceraconic, circular in cross section, and of moderate size, the holotype having a diameter of 21 mm. orad. Conch shows a moderate expansion orad, the apical angle being 5 degrees. Sutures straight and directly transverse to the long axis of the conch. The siphuncle is subcentral, being a little ventrad the middle, small in its passage through the septa but expanded within



the camerae, where it is subcylindrical. The internal cast is smooth, and the outer shell is missing, but a portion of the inner shell is preserved which shows the fine transverse growth lines which swing apicad ventrally to mark the position of the hyponomic sinus, and in addition there are finer longitudinal striae which are so faint that they show only under magnification. The camerae are rather long, being about  $2/3$  the shell diameter.

Remarks-. From Miller's generic diagnosis we have already noted on p. 6 that this genus has been erected for forms that are "devoid of ornamentation other than the transverse growth lines." Possibly this form represents a new genus. Again, however, the exceptional preservation of the Buckhorn specimens must be considered. The longitudinal striae are so faint that they could easily be lost in the ordinary processes of fossilization. The writer feels that until otherwise proven it is better to place his form under the genus Dolorthoceras and to treat the data on the surface markings as additional generic information than to attempt to separate two very similar forms on an obscure point.

Suborder ORTHOCHOANITES Hyatt 1900

Family ORTHOCERATIDAE M'Coy 1844

Genus Orthoceras Bruguiere 1789

There is considerable uncertainty at present as to the exact status of the genus Orthoceras, s. str. Miller, Dunbar, and Condra (1933, pp.58-65) have given a good summary of the genus and the writer has followed them in crediting the genus to Bruguiere. Some authors limit Orthoceras, s. str. to the genotype Orthoceras regulare (Schlotheim) and one other species, Orthoceras bifoveatum Noetling, both from the Ordovician of northern Europe. The writer has failed to find any great departure in his specimens from those of Orthoceras in the limited sense, and so has classified his species under that genus. The writer did not, however, find the "densely crowded minute longitudinal ribs" of Troedsson (1931, p.12) although the preservation of the Buckhorn specimens is almost perfect. Possibly a new genus could be erected for the following species on the basis that some of the septal necks are very slightly recurved; they are, however, essentially straight and some are perfectly so. Such being the case the writer does not feel justified in attempting to erect a new genus on such a fine, variable distinction.

Orthoceras unicamera, n.sp.

Plate I, figs. 1-3

Orthoceraconic; circular section; walls almost parallel,

the apical angle being two degrees; surface marked by fine striae or growth lines of the angular overlap type, which measure about ten to the millimeter, are straight and directly transverse to the long axis of the conch. Diameter of shell small, usually between 5 and 6 mm. Camerae long, the septal spacing being approximately equal to the shell diameter; sutures straight, directly transverse to the long axis of the conch, and septa moderately convex apicad. Siphuncle moderately small (about  $1/7$  the diameter of the shell) and central in position; orthochoanitic, that is, the septal necks are short and straight and the connecting rings are cylindrical and not appreciably expanded within the camerae. No body chambers or tips were recovered.

Remarks-. There is a strong possibility that this form is identical with Orthoceras wapamuckense Girty. Girty (1909, p.44) states that "the surface is apparently entirely smooth." The Buckhorn orthocerids are exceptionally well preserved, and the fine cross striae are very distinct. Possibly the differentiation of these two species is merely one of preservation, the growth lines not having been preserved on Girty's species. The writer believes it best to consider the two as separate species, however, unless it can be shown that Orthoceras wapamuckense Girty has growth lines similar to those of the writer's species. Girty (1909, p.45) does record one instance of "somewhat wavy cross striae, like those of Bactrites ? smithianus." He goes on to say that these markings are evidently on the inner shell, the surface shell being apparently smooth. Orthoceras unicamera, n.sp. is also somewhat similar to Orthoceras longissimicameratum Miller, a long chambered form from the upper Gaptank of West Texas. That species has fine cross striae, but its camerae are slightly shorter and its apical angle greater than the writer's species.

Orthoceras gracile, n.sp.

Plate I, figs. 4-6

Orthoceraconic, circular in section, and usually small, the average diameter being about 3 to 4 mm. Walls moderately expanding, the apical angle being 5 degrees. Surface of shell is marked by regular rounded striae or growth lines, about 20 per mm. which are straight and directly transverse to the long axis of the conch; septa moderately convex apicad. Siphuncle moderately small (about  $1/7$  the diameter of the shell) and central; orthochoanitic, that is, the septal necks are short and straight and the connecting rings are cylindrical and not appreciably expanded within the camerae. No body chambers were observed, but this species has yielded several tips, or apicad extremities.

Remarks-. This species is evidently rather similar to Orthoceras longissimicameratum Miller. That species, however, has a higher apical angle and the cross striae are coarser. The writer's species may also be confused with Orthoceras wapamuckense Girty, a smooth shelled form, as the cross striae of Orthoceras gracile, n.sp. are often so fine as to be imperceptible to the naked eye, but the writer's species has a higher apical angle. Orthoceras gracile, n.sp. is best distinguished in the same manner from Orthoceras unicamera, n.sp., that species having a lower apical angle, and, in addition, heavier cross striae.

Orthoceras indianum var. buckhornense, var. nov.

Plate I, fig. 7

1909. Orthoceras indianum Girty, U. S. Geol. Survey Bull. 377, p. 47, pl. 6, figs. 13, 13a.

Orthoceraconic, circular in section, and small, the average diameter being 4 to 5 mm. Walls almost parallel, the apical angle being 2 degrees. Surface of shell marked by very fine, regular, flattened transverse striae, or growth lines which are straight and directly transverse to the long axis of the conch. Camerae moderately long, there being about 2 camerae per diameter; sutures straight and directly transverse to the long axis of the shell; septa moderately convex apicad. Siphuncle moderately small (about  $\frac{1}{7}$  the diameter of the shell) and central; orthochoanitic, that is, the septal necks are short and straight and the connecting rings are cylindrical and not appreciably expanded within the camerae.

Remarks-. The general characteristics and septal spacing of this form clearly show a marked relationship to Orthoceras indianum Girty. The only marked difference lies in the surface sculpture. The annulations of Orthoceras indianum Girty are coarser, about five annulations and five striae occurring in a space of two millimeters, the annulations being flat and nearly as broad as the intervals which separate them. The annulations of the writer's variety are finer, about ten annulations and ten striae occurring in a space of two millimeters, and the flat annulations are somewhat broader than the intervals which separate them.

Orthoceras tricamerae, n.sp.

Plate I, figs. 8, 9

Orthoceraconic, circular section, and small, the average diameter being 4 to 5 mm. Walls moderately expanding, the apical angle being 4 degrees. Shell surface so finely marked by directly



transverse growth lines as to appear smooth to the naked eye; when magnified these growth lines are seen to be flat, low, somewhat irregular in width and spacing, and generally narrower than the intervals separating them. Camerae rather short, there being about three camerae per diameter; sutures straight and directly transverse to the long diameter of the conch; septa moderately convex apicad. Siphuncle moderately small (about  $1/7$  the diameter of the shell) and central; orthochoanitic, that is, the septal necks are short and straight and the connecting rings cylindrical and not appreciably expanded within the camerae.

Remarks-. This species is rather similar to Orthoceras choctawense Girty, and may possibly be a variation of that species. The surface markings, however, are different. The annulations of that species are angular, regular, and there are about 3 per mm.; those of Orthoceras tricamerae, n.sp. are flat, irregular, and finer, there being about 5 per mm.

#### Family TRIGONOCERATIDAE Hyatt 1883

##### Genus Ephippioceras Hyatt 1883

This genus was established by Hyatt (1883, p.290) in his monograph on the "Genera of Fossil Cephalopods" and the reader is referred to that work for the generic diagnosis. An excellent summary is also given by Miller, Dunbar, and Condra (1933, pp.112-114).

##### Ephippioceras ferratum (Cox)

Plate I, fig. 17

1857. Nautilus ferratus Cox, Kentucky Geol. Survey Rept. 3, pp. 574-575, pl. 10, figs. 2,2a.  
 1933. Ephippioceras ferratum Miller, Dunbar, and Condra, Nebraska Geol. Survey Bull. 9, 2nd ser., pp. 112-118, pl.3, figs.14-17.

The location of the type specimens of Ephippioceras ferratum is not known, and the following description is based on previously published data: Conch subglobose, nautiliconic, and at maturity consists of about three volutions. These expand rapidly, and all but the first volution, which is subcircular or subelliptical in section, are reniform in cross section, being depressed, broadly rounded ventrally, more narrowly rounded laterally, and impressed dorsally. The umbilicus is small but deep, the umbilical shoulder being rounded and indistinct; the umbilical walls are steep and essentially straight. The shell is involute, the inner whorls not being exposed. The camerae are relatively short, about eight of them occurring in a distance (measured along the medial portion of the lateral wall) equal to

the lateral diameter of the conch. The sutures are approximately transverse to the long axis of the conch. Each external suture forms a broad, deep, subacute ventral saddle, and a shallow broad slightly asymmetrical lateral lobe, and a shallow rounded umbilical saddle. Hyatt states that there is a broad shallow dorsal lobe divided by a slight median saddle. The internal molds are smooth, except for a small but distinct rounded ridge on the venter. The surface of the conch is apparently smooth except for growth lines. The siphuncle is small and migrates from a slightly ventrad to a central position.

Remarks-. The figured specimen, which is a portion of the venter, is so incomplete that it fails to show most of the characteristics of the species. It indicates a form whose transverse diameter is at least 32 mm., and the venter and sutures of which are identical with those of Ephippioceras ferratum (Cox). As this species has been separated from the European species largely on the basis of the depth of the ventral saddle, the writer believes that the data on his specimen is sufficient to allow this identification. A small portion of the original shell surface is preserved on the specimen, but nothing can be seen of the sculpture.

Family TAINOCERATIDAE Hyatt 1883

Genus Temnocheilus M'Coy 1844

This genus was established by M'Coy (1844, p.20) as a subgenus of Nautilus. It is well summarized and described by Miller, Dunbar, and Condra (1933, pp.156-160) and the reader is referred to them for the generic diagnosis.

Temnocheilus milleri, n.sp.

Plate I, figs. 18-20

This species is based on a single specimen, which, unfortunately, is not complete. It is, however, so distinct from previously described species that the writer feels justified in making it the holotype of a new species.

This species may be briefly characterized as follows:  
Conch appears to be rather large for this genus; subglobose and tarphyceraconic. Section subtrapezoidal, and the whorl width is more than twice the whorl height. The dorsum is moderately impressed, and the venter is very convex, this being an important specific marker.

The available measurements for the holotype are:

|                   |         |
|-------------------|---------|
| Diameter (D) est. | 130 mm. |
| Whorl height (A)  | 26      |
| Whorl width (C)   | 60      |

The tubercules, which are situated at the junction of the ventral area with the dorso-lateral area are prominent and distinct that is, they are not confluent. They are about 4.5 mm. high and conoidal, being but slightly elongate longitudinally. There are about four tubercules on the holotype and it is estimated that the complete whorl would have about 14 or 15.

The septa are about 12 mm. apart on the venter. They form a very shallow ventral lobe, sharp ventro-lateral saddle, and a narrow umbilical lobe. The course across the dorsum is obscured.

Remarks-. This species is best distinguished by its very convex venter, the convexity being such as to cause the tubercules to assume a medial position when the specimen is viewed laterally, and by the steepness of the umbilical walls.

#### Genus Metacoceras Hyatt 1883

This genus was established by Hyatt (1883, pp.268-269). Miller, Dunbar, and Condra (1933, pp.166-170) have given an excellent summary and diagnosis to which the writer has nothing to add, and the reader is referred to that publication for the generic description.

#### Metacoceras sp.

#### Plate I, figs. 21,22

This form is represented by a single fragmental specimen which is entirely septate. It may be described as follows: cross section typical hexagonal; compressed laterally, the whorl height and width being equal; lateral walls straight and essentially parallel, although slightly convergent toward the rather strongly convex venter; ventro-lateral margins sharp subangular and marked by a line of longitudinally elongate nodes that are about one septal space apart. Umbilicus rather small for this genus, being about  $1/3$  the diameter; umbilical shoulders smooth, sharply rounded; umbilical walls almost straight and inclined to the lateral walls at an angle of about 135 degrees.

The measurements of the specimen, some estimated as indicated, are as follows:

|                                |        |
|--------------------------------|--------|
| Diameter (D) est.              | 45 mm. |
| Whorl height (A)               | 15     |
| Whorl width near umbilicus (C) | 15     |
| Whorl width near venter (V)    | 14     |
| Diameter of umbilicus (U)      | 15     |

The septa are rather closely spaced, being about 3 mm. apart (medial lateral) where the whorl height is 15 mm. Each suture forms a broad shallow rounded ventral lobe, indistinct



ventro-lateral saddles, and moderately deep rounded lateral lobes. Internal sutures and umbilical sutures not known.

Remarks-. Too little of this form is preserved to justify even a tentative specific determination. It evidently belongs to one of the laterally compressed species with a moderate size umbilicus, and with umbilical shoulders (of the internal cast at least) that are free of nodes. The quite convex venter of this form is probably of little significance, as most of the species of Metacoceras are more convex ventrally in the earlier whorls.

Family KONINCKOCERATIDAE Hyatt 1893

Genus Domatoceras Hyatt 1891

This genus was established by Hyatt (1891, pp.342-343) in a confused description that was clarified by his later paper (1893, pp.440-446). The reader is referred to Miller, Dunbar, and Condra (1933, pp.215-218) for a comprehensive summary and diagnosis of this genus, which is well represented in the writer's collection from the Buckhorn.

Domatoceras robustum, n.sp.

Plate I, figs. 23-25

Tarphyceraconic; large and robust; subdiscoidal, being strongly compressed laterally; height (A) of the last whorl is about 1 1/2 times the maximum whorl width (C) which is attained just ventrad the umbilical shoulders; width (V) near the venter is about 2/3 the maximum width, the almost straight lateral walls converging toward the venter; venter flattened, slightly convex, and the ventro-lateral margins sharply rounded. Rapid expansion orad, particularly of the whorl height; impression slight; umbilicus perforate and large, measuring about 1/3 the diameter of the shell. The umbilical shoulders of the mature part are broadly rounded and the walls steep, but in the earlier whorls the shoulders are subangular to angular. Type specimen consists of two volutions and is entirely septate, but the crowding of the septa orad would indicate that the form is almost complete, probably only the living chamber being missing.

The measurements of the type specimen are as follows:

|                                       |         |
|---------------------------------------|---------|
| Diameter (D)                          | 147 mm. |
| Whorl height (A)                      | 67      |
| Whorl width near the umbilicus (C)    | 43      |
| Whorl width near the venter (V)       | 28      |
| Diameter of umbilicus (U)             | 52      |
| Depth of umbilicus (L)                | 13      |
| Impression (I) obscured but less than | 3       |

The ventro-lateral margins of the internal cast are smooth, but the ventro-lateral margins of the test are marked by longitudinally elongate nodes which are about 14 mm. apart in the mature portion of the shell. The shell wall is thick, measuring at least 5 mm. in the medial portion of the lateral wall, and more ventrad.

Each septa forms a broad shallow lateral lobe, a rather obscure saddle on the rounded umbilical shoulders, and descends nearly straight down the umbilical walls. The ventral and internal sutures are not known. Extremely crad the septa are closely crowded, being 5.5 mm. apart where the whorl height (A) is 67 mm., a ratio of 12 : 1. At about the same position in the preceding whorl this ratio is about 5 : 1.

Remarks-. This species is represented by a single incomplete specimen, which however, displays well the specific characters, which are clearly those of a hitherto undescribed form. This species is very similar to the genotype, Domatoceras umbilicatum Hyatt, which is also a large form. It differs from that species in having a larger umbilicus, more abruptly rounded umbilical shoulders, and in being more compressed laterally.

Domatoceras buckhornense, n.sp.

Plate I, figs. 26, 27

Tarphyceracenic; rather large size; subdiscoidal, being strongly compressed laterally; the maximum width (C) of the cross section measures less than half the height (A), and is attained at the umbilical shoulders; the ventral width is but little less than the maximum width as the almost straight lateral walls are but slightly convergent toward the venter. The venter is flattened and the ventro-lateral margins are angular, forming nearly right angles. The umbilical shoulders of the internal cast are distinct and rounded, and the same is even more true of the surface of the test because of thickening of the umbilical walls. The umbilical walls are straight crad and are inclined to the lateral walls at an angle of about 150 degrees; in the earlier whorls the umbilical walls become steeper and then rounded, but this is a generic rather than a specific characteristic. The umbilicus is large, being greater than  $1/3$  the diameter of the shell; this large size is due to the rapid expansion of the whorl height (A) and to the slight impression of the whorls, which are but little more than in contact.

The measurements of the type specimen are:

|                                |        |
|--------------------------------|--------|
| Diameter (D)                   | 93 mm. |
| Whorl height (A)               | 35     |
| Whorl width near umbilicus (C) | 15     |
| Whorl width near venter (V)    | 12     |

## Diameter of the umbilicus (U)

37

The ventro-lateral and the dorso-lateral margins of the internal cast are smooth, but the ventro-lateral borders of the test are marked with conoidal nodes that are spaced nearly one per septa. These nodes are low, but distinct.

The septa form wide shallow rounded lateral lobes and rather obscure saddles on the umbilical shoulders, then descend nearly straight down the umbilical walls. The dorsal and ventral sutures are not known. At a point where the whorl height (A) is 21 mm. the septa are about 6 mm. apart, giving a ratio of about 3 1/2 camerae per whorl height.

Remarks-. This species is distinguished by its almost straight and nearly parallel walls; by its strong lateral compression; by its large umbilicus; by the subangular umbilical shoulders; and by the gently sloping umbilical walls. The size is rather large, but not nearly so large as Domatoceras umbilicatum Hyatt or Domatoceras robustum, n.sp., neither of which is as discoidal as Domatoceras buckhornense, n.sp.

Domatoceras parallelum, n.sp.

Plate I, figs. 33-35

Tarphyceraconic; rather small; subdiscoidal, being strongly compressed laterally, the height of the whorl being a little less than twice the width; the straight lateral walls are parallel; venter is gently rounded and the junctions with the lateral walls are subangular. Conch expands rather rapidly orad, particularly in whorl height; impressed zone very slight; umbilicus large, measuring about 1/3 the shell diameter; umbilical shoulders of the internal cast smooth and rounded throughout, more sharply so in the earlier whorls, and the walls, which are vertical in the earlier whorls become less steep orad. Where the shell is present the umbilical shoulders are made subangular by thickening of the shell at that point.

The measurements of the holotype are:

|                                              |        |
|----------------------------------------------|--------|
| Diameter (D)                                 | 46 mm. |
| Whorl height (A)                             | 20     |
| Whorl width (C and V equal)                  | 12     |
| Diameter of umbilicus (U)                    | 15     |
| Impression (I), barely more than in contact. |        |

The surface of the shell is marked by fine, sinuous growth lines which show a fairly deep hyponomic sinus. The ventro-lateral margins of the shell are nodose, the nodes being moderately pronounced and somewhat elongate longitudinally. The internal cast is likewise, though less distinctly, marked by these ventro-lateral



nodes. The internal cast of Domatoceras is generally smooth, but the writer has observed similar nodosity on the internal cast of the holotype of Domatoceras (Discites) toddanum (Gurley).

The septa are rather poorly preserved but apparently follow the usual Domatoceras pattern. They are not very closely spaced, there being about four septa in a distance equal to the whorl height (A).

Remarks-. This species is distinguished from all other species of Domatoceras by its parallel lateral walls. In fact, the species is given its present classification with some hesitation, as the convergence of the lateral walls ventrad is regarded as a generic marker. However, as all the other characteristics are in accord with Domatoceras the writer feels justified in placing the species in that genus.

Domatoceras angularum, n.sp.

Plate I, figs. 28-30

Tarphyceraconic; moderate size; subdiscoidal, being strongly compressed laterally; maximum whorl width attained just ventrad the umbilical shoulders, the almost straight lateral walls converging toward the convex, almost flat venter; rapid expansion, particularly of the whorl height, orad; impression evidently slight. Umbilicus rather large, being a little more than  $1/3$  the diameter; adapically the umbilical shoulders are abruptly rounded and the umbilical walls are steep, being almost perpendicular to the lateral walls; adorally the umbilical shoulders become sharper, almost subangular, and the umbilical walls, which become concave near the aperture, become less steep, forming angles of about  $130^\circ$  degrees with the lateral walls.

The measurements of the type specimen are:

|                                              |        |
|----------------------------------------------|--------|
| Diameter (D) est.                            | 65 mm. |
| Whorl height (A)                             | 32     |
| Whorl width near umbilicus (C)               | 23     |
| Whorl width near venter (V)                  | 18     |
| Diameter of umbilicus (U) est.               | 24     |
| Impression (I) not known but thought slight. |        |

The umbilical shoulders of the internal cast are smooth, but the ventro-lateral margins are marked by a row of low longitudinally elongate nodes which are much more prominent on the test. Only the extreme orad portion of the test is preserved. It shows the ventro-lateral nodes mentioned above, and in addition, a faint fine ridge on the umbilical shoulder which persists for at least half the length of the living chamber, which is as far as the shell surface is preserved. The only other ornamentation

is the fine growth lines, which measure about 5 per mm., these show a deep, sharply rounded hyponomic sinus, a low rounded lateral crest, a shallow rounded sinus just ventrad the umbilical shoulders and a more sharply rounded umbilical crest.

The sutures are not well preserved on the type specimen, only the last one being preserved. They appear to conform to the usual Domatoceras type.

Remarks-. This species may be readily distinguished by the concavity of the umbilical walls of the living chamber, both of the test and of the internal cast. This concavity is evidently acquired in the last stages of growth. Some difficulty might be encountered in distinguishing the internal cast of this species from the internal cast of Apheleceras falciferum Yin. The venter of Apheleceras is concave and the ventro-lateral margins are smooth; the venter of Domatoceras is convex and the ventro-lateral margins are noded. The problem of differentiation is not that simple, however. The concavity of the venter of Apheleceras is attained only in the mature forms or stages, the earlier stages having a convex venter; and the internal casts of Domatoceras are usually free of nodes. The section of Apheleceras falciferum given by Yin (1933, p.9) is evidently of an immature individual or portion as the venter is shown as being slightly convex.

Domatoceras angularum var. modestum, n.sp.

Plate I, figs. 31,32

This variety conforms to the general Domatoceras angularum, n.sp. characteristics, with some variation. The type is a fragmental specimen consisting of a portion of the living chamber and some 12 camerae. It may be briefly characterized as follows: Form subdiscoidal, being strongly compressed laterally; ratio of whorl height to width almost 2 : 1. Lateral walls are essentially straight and slightly convergent toward the flattened venter. Umbilicus moderately large, being about 1/3 the diameter; umbilical shoulders distinct and sharply rounded; adapically the umbilical walls are straight and almost perpendicular to the lateral walls, but orad they become less steep and acquire the slight concavity that is an important specific characteristic. Moderately rapid expansion orad, particularly of the whorl height; amount of impression not known.

The measurements of the type specimen are as follows:

|                              |        |
|------------------------------|--------|
| Diameter (D) est.            | 53 mm. |
| Whorl height (A)             | 22     |
| Whorl width at umbilicus (C) | 12     |
| Whorl width at venter (V)    | 10     |

## Diameter of umbilicus (U)

14

The surface of the internal cast at least is free of nodes. The ventro-lateral margins of the internal cast bear some evidence of a ridge, but this feature is quite obscure and may be the result of slight distortion. A small portion of the shell is preserved on the venter, and this shows a moderately deep subacute hyponomic sinus.

The septa conform to the usual Domatoceras pattern. There is a shallow ventral lobe, subacute ventro-lateral saddle, wide shallow rounded lateral lobe, and an indistinct saddle on the umbilical shoulder where the septa straighten to descend abruptly down the umbilical walls. The septa are rather closely spaced, there being about 5 camerae in a distance equal to the whorl height (A). Extremely orad the septa are crowded, indicating a mature individual.

Remarks--. This form bears a somewhat close resemblance to Domatoceras (Discites) toddanum (Gurley) from the Westerville limestone at Kansas City. That species, however, has a smaller umbilicus, is less compressed laterally, and does not have the concave umbilical walls. The variety is distinguished from the parent species by being slightly more compressed laterally and by the umbilical walls being almost twice as steep in the extreme orad portion.

Domatoceras sp.

Plate I, figs. 36, 37

This form is represented by a single specimen that is fragmental and evidently a portion of the living chamber, as no septa are present. The shell is slightly crushed, but a little restoration permits the following description: Form subdiscoidal; the whorl height (A) is 45 mm. and this measurement is but little greater than the maximum whorl width (C) which is attained just ventrad the umbilical shoulders and is 37 mm. The lateral walls are essentially straight and converge toward the venter, where the whorl width (V) is 24 mm. The venter is flattened and the ventro-lateral margins of the internal cast are smooth and sharply rounded; the ventro-lateral margins of the test are subangular and marked by a line of low heavy longitudinally elongate nodes. The umbilicus is evidently rather large, the shoulders distinct and rounded, and the walls steep; impression slight.

The shell wall is strong and heavy, being 5 mm. thick on the lateral wall, and greater at the ventro-lateral nodes. The growth lines are rather indistinct; they form a shallow rounded hyponomic sinus, a broad rounded lateral crest, and a dorso-



lateral sinus. The venter is further marked by fine longitudinal striae, but these are not seen on the rest of the shell.

Remarks-. This specimen is rather puzzling. It is distorted slightly, the venter being concave apicad and flattened convex orad. The writer believes that the concavity is caused by distortion, the venter being normally convex. This form is evidently similar to Domatoceras robustum, n.sp. but is slightly less compressed laterally and more convergent ventrally; it is also similar to Domatoceras umbilicatum Hyatt but is more compressed laterally and less convergent ventrally than that species. Evidently this specimen occupies an intermediate position between the two species mentioned above.

Genus Pseudometacoceras Miller, Dunbar, Condra 1933

This genus was established by the authors (1933, p.224) on the species Metacoceras sculptile Girty. The reader is referred to their publication for the generic diagnosis.

Pseudometacoceras ? sp.

Plate I, figs. 39-41

This form is represented by a single fragmental specimen of such doubtful affinities that the above classification is given with considerable doubt. The major portion of one volution is all that is preserved. The specimen is entirely septate and the earlier whorls and living chamber are missing, but the whorl section suggests that the preserved portion is of a mature whorl.

A restoration of this specimen may be described as follows: Conch subdiscoidal; tarphyceraconic; number of volutions unknown; rather rapid expansion orad, particularly of the whorl height; lateral walls essentially straight and parallel; venter flattened, slightly concave orad but less so apicad; ventro-lateral margins sharply rounded and bearing a row of nodes that are prominent orad but become fainter and apparently disappear apicad (this characteristic is strongly suggested but not clearly displayed because of the poor preservation apicad). Umbilical shoulders sharp and subangular on the test, more rounded on the internal cast; umbilical walls straight and not steep, being inclined to the lateral walls at an angle of about 120 degrees; umbilicus fairly large, measuring about  $1/3$  the diameter of the shell; impression slight.

The measurements of the specimen are as follows:

|                       |        |
|-----------------------|--------|
| Diameter (D)          | 54 mm. |
| Whorl height (A)      | 24     |
| Whorl width (C and V) | 13     |

Diameter of umbilicus (U)

18

The shell surface is not well preserved but enough of it remains to show a moderately deep hyponomic sinus. The growth lines on the lateral walls cannot be distinguished.

The sutures show a rather weak ventral lobe that is succeeded on either side by a rather sharply rounded ventro-lateral saddle and broad shallow lateral lobe; a weak saddle is formed on the umbilical shoulders, the sutures then descending nearly straight down the umbilical walls; internal sutures not known.

Remarks-. The above description is of a form that shows many departures from typical Pseudorthoceras. The form is almost discoidal, instead of the whorl height and width being subequal: the walls are parallel instead of being convergent ventrally; the venter is slightly concave (orad) instead of being flat. Many of these characteristics point to an affinity with Apheleceras but the ventro-lateral nodes, which apparently die out apicad (although this point is somewhat doubtful) favor the identification given. The writer regards this classification as most unsatisfactory, but can suggest no better one.

Family SOLENOCHILIDAE Hyatt 1893

Genus Solenochilus Meek and Worthen 1870

This genus was established in 1870 by Meek and Worthen (1870, p.47). Miller, Dunbar, and Condra (1933, pp.228-232) have recently given a good summary and diagnosis of the genus, and the reader is referred to their work.

Solenochilus ? sp.

Plate I, fig. 38

This specimen is too incomplete for even moderately certain identification and it is mentioned here because it is one of the few Buckhorn forms that is not strongly compressed laterally.

The specimen is a portion of the phragmacone, being entirely septate. The section is rather strongly depressed, the whorl width (46 mm.) being exactly twice the height (23 mm.). The venter is broadly rounded and the lateral walls are more sharply rounded. The umbilicus is small, the shoulders rounded, and the walls abrupt.

A very small portion of the shell is preserved on the venter showing longitudinal striae as well as the usual transverse growth lines.

The sutures are slightly oblique to the long axis of the conch, and are not quite straight, as each forms a broad shallow ventral lobe; septal spacing of 4 per whorl width.

## II. THE AMMONOIDEA

The preservation of the ammonoids of the deposit is in general better than that of the nautiloids. The ammonoids, however, present neither the abundance nor the variety exhibited by the nautiloids. Six genera, including two proposed new ones, and thirteen species, including six proposed new ones, were recognized. The same tendency is seen in this order as in the nautiloids---a tendency toward the discoidal form even in those genera which are usually more or less globose. One of the proposed genera, Ambiguites, n.g. is represented by one of the largest known Carboniferous ammonoids.

A list of the ammonoids of the Buckhorn is as follows:

- Milleroceras parrishi (Miller and Gurley)
- Gonioloboceras bicanaliculatum, n.sp.
- Gastrioceras buckhornense, n.sp.
- Gastrioceras kansasense (Miller and Gurley)?
- Gastrioceras n.sp.
- Gastrioceras sp.
- Gastrioceras sp.
- Gastrioceras cf. subcavum (Miller and Gurley)
- Gastrioceras ? sp.
- Ambiguites gargantum, n.g., n.sp.
- Paralegoceras discus, n.sp.
- Walkerites plummeri, n.g., n.sp.
- Walkerites vulgaris, n.g., n.sp.

## Description of the Genera and Species

Order AMMONOIDEA Zittel 1884

Family GEPHYROCERATIDAE Haug 1898

Subfamily PRIMORDIALINAE Hyatt 1883

Genus Milleroceras Hyatt 1900

This genus was established by Hyatt (1900, p.550) but not described. Recently Miller (1932, p.69) has given a diagnosis and history of the genus, and the reader is referred to his work for further information.

Milleroceras parrishi (Miller and Gurley)

Plate II, figs. 1-3

- 1894. Goniatites sp.? Keyes, Missouri Geol. Survey, vol. 5, pl. 56, fig. 1.
- 1932. Milleroceras parrishi Miller, Jour. Paleontology, vol. 6, no. 1, pp. 72-73, pl. 12, figs. 5-7.



This species is represented by a single small specimen which is slightly crushed and entirely septate; however, the specific characters are quite apparent, due allowance being made for the slight crushing.

The specimen may be briefly described as follows: Form subdiscoidal, being compressed laterally, the ratio of the whorl height (A) to the maximum width (C) being 7 : 5. The writer believes that because of the slight crushing the value for "A" is a little greater and the value for "C" a little less than it should be. The diameter of the umbilicus, which is very small, has probably been decreased for the same reason. The maximum width of the whorl is attained slightly ventrad the umbilical shoulders; near the umbilicus the lateral walls are flattened and almost parallel to each other, but ventrad the middle of the whorl they become more convex and converge toward the rather sharply rounded venter. The umbilicus is very small, but deep; the umbilical walls are rather steep. Rapid whorl expansion orad, particularly of the whorl height; impression great.

The actual measurements of the specimen (without allowance for distortion) are as follows:

|                                |          |
|--------------------------------|----------|
| Diameter (D)                   | 13.5 mm. |
| Whorl height (A)               | 7.0      |
| Whorl width near umbilicus (C) | 5.0      |
| Whorl width near venter (V)    | 3.0      |
| Diameter of umbilicus (U)      | 1.0      |

Only a fragment of the test wall is preserved, and this is only large enough to indicate rather fine regular lines of growth measuring about 5 per mm. The surface of the internal cast at least is free of nodes, carinae, or constrictions.

Each external suture consists of a broad ventral lobe, which is divided by a short broad median saddle; the two subdivisions of the ventral lobe are asymmetrical and obtusely pointed and the median saddle is notched by a small tertiary lobe. The large ventral lobe is followed on either side by a deep, rather narrow rounded saddle, a broad asymmetrical "V" shaped lateral lobe, and a shallow, broadly rounded asymmetrical lateral saddle. The umbilicus is slightly obscured and the character of the umbilical lobe cannot be determined.

Remarks-. The writer has compared his specimen with the holotype, 6209 U C, in Walker Museum, University of Chicago, and considers this classification satisfactory, due allowance being made for the slight distortion that the specimen has suffered.

Genus Gonioloboceras Hyatt 1900

Hyatt (1900, p.551) introduced the genus Gonioloboceras in Zittel-Eastman "Textbook of Paleontology" but did not describe the genus, merely indicating the type, Gonioloboceras (Goniatites) goniolum (Meek). The reader is referred to Meek's description of that species for the generic diagnosis.

Gonioloboceras bicanaliculatum, n.sp.

Plate II, figs. 4,5

Form discoidal, being strongly compressed laterally, although the exact ratio of whorl height to width cannot be obtained from the holotype. Lateral walls moderately convex, the greatest convexity occurring at about the medial portion; venter narrow, rounded, and smooth. Rapid expansion orad, particularly of the whorl height; umbilicus closed, the form being entirely involute, and impression complete.

The available measurements of the holotype are:

|                             |        |
|-----------------------------|--------|
| Diameter (D)                | 77 mm. |
| Whorl height (A)            | 46     |
| Whorl width near venter (V) | 12     |

The internal cast is free of nodes or carinae, but each lateral wall bears two longitudinal grooves that are the markers of the species. The first groove is situated a little dorsad the venter and throughout its course forms a channel connecting the acutely pointed "pseudo-lateral" lobes (these lobes are really portions of the divided ventral lobes). Adapically this groove is inconspicuous; adorally it becomes quite distinct, although neither wide nor deep. Dorsad this first groove and forming a longitudinal channel connecting the points of the true lateral lobes is the second groove. Like the first, this groove is indistinct adapically, but widens and deepens adorally. Extremely orad, or in about the last quarter volution (of the holotype), the widening becomes so great that the grooved character is lost, and the lateral wall is flattened from the very small umbilicus to a point a little dorsad the line of the lateral lobes. Ventrad this flattened area the lateral walls rise convexly, and then converge toward the rounded venter.

The septa are similar to those of Gonioloboceras goniolum (Meek). The lateral extremities of the broad ventral lobe forms a pseudo-lateral acutely pointed lobe on either wall; these are succeeded, in order, by a lateral saddle and a lateral lobe, both asymmetrical and acutely pointed, and then by a more shallow rounded umbilical saddle.

Remarks-. This species is distinguished from all others by the two longitudinal grooves on each lateral wall. It is possible that this grooved character is of generic significance, but as all other characteristics accord with those of Gonio-loboceras the writer believes it best to include his form under that genus until otherwise proven.

Superfamily GLYPHIOGERATIDAE Hyatt 1883

Family GLYPHIOGERATIDAE Hyatt 1883

Genus Gastrioceras Hyatt 1883

The reader is referred to Hyatt's (1883, p.327) original description for the generic diagnosis. The exact standing of the genus is somewhat doubtful and the reader is referred to Girty (1915, pp.248-254) for a discussion of the species.

Gastrioceras buckhornense, n.sp.

Plate II, figs. 6-8

Form subdiscoidal, being rather strongly compressed for this genus; whorl section helmet-shaped, the whorl height (A) being the same as the width (C). Impression about  $1/2$  the whorl height, and although the whorl expansion is moderate the umbilicus is large, being slightly more than  $1/3$  the diameter of the shell. These facts indicate a large number of volutions, but this observation cannot be checked as the inner umbilicus is obscured by a conglomeratic matrix which cannot be removed without injury to the specimen. At least three volutions are visible. The umbilical shoulders are subangular and the walls nearly vertical. The venter and the lateral walls are rather evenly rounded. The surface of the internal cast at least is free of nodes and constrictions.

The measurements of the holotype are as follows:

|                           |         |
|---------------------------|---------|
| Diameter (D)              | 106 mm. |
| Whorl height (A)          | 41      |
| Whorl width (C)           | 41      |
| Diameter of umbilicus (U) | 37      |
| Impression (I)            | 20      |

There are nine lobes and saddles of the gastrioceran type; the ventral saddle and lobes are more pronounced than usual. There is a rather large rounded ventral saddle which is succeeded on either side by a large acutely pointed ventral lobe, a wide hastate lateral saddle, a wide acutely pointed lateral lobe, a subhastate 2nd lateral saddle, and a short broad pointed lobe on the umbilical wall. Internally this is followed by a broadly rounded saddle, a broad pointed tongue-shaped lobe, a more narrow rounded saddle, and narrow pointed anti-siphonal lobe.



Remarks-. This species is very similar to Gastrioceras compressum (Meek), a much older form, both in shape and in sutural expression. That species, however, has a relatively larger umbilicus, is slightly less compressed laterally, and bears constrictions, differing in all these points from the writer's species.

Gastrioceras kansasense (Miller and Gurley)?

Plate II, fig. 9

1896. Goniatites kansasense Miller and Gurley, Bull. Illinois State Mus. Nat. Hist., no. 11, p. 43, pl. 5, figs. 9-11.  
 1903. Gastrioceras kansasense Smith, U. S. Geol. Survey, Mono. 42, pp. 91-92, pl. 17, figs. 9-11.

A number of small, more or less poorly preserved specimens from the writer's collection are doubtfully referred to this species. None of them are complete, but a typical specimen may be described as follows: Shell small, the diameter being 16.5 mm.; whorls increase slowly in size, depressed helmet-shaped and rather deeply embracing, being indented to about half their height by the preceding whorls. Width of whorl section is 11 mm., or approximately  $\frac{2}{3}$  the diameter of the shell and nearly twice the whorl height of 6 mm. The umbilicus, which is slightly obscured, has a diameter of 6 mm., being a little more than  $\frac{1}{3}$  the shell diameter. Surface of the internal cast at least is not marked by ribs.

Remarks-. A comparison of the above description with Smith's description of Gastrioceras kansasense (Miller and Gurley) at once shows a marked similarity; but as the writer's specimens are very poorly preserved the identification is left open.

Gastrioceras sp.

Plate II, fig. 11

The description of a typical specimen is as follows: Shell small, the diameter being 15 mm.; whorl height 4 mm.; impression obscured but evidently not more than  $\frac{1}{3}$ ; form quite evolute, the umbilicus measuring 7.5 mm., or  $\frac{1}{2}$  the diameter, and shallow. Shell consists of four volutions, with about three constrictions per revolution; strong umbilical tubercles which swing slightly orad ventrally. Sutures, surface ornamentation, and whorl width not known.

Remarks-. The only specimens recovered are imbedded in a matrix and only a lateral view of the form can be obtained. A marked similarity to Gastrioceras listeri (Martin), Gastrioceras carbonarium (von Buch) and Gastrioceras marianum (M.V.K.) is at once apparent. These three species are separated largely on the basis of whorl width and sutural expression, neither of which is

shown on the Buckhorn specimens. The closest resemblance is to Gastrioceras listeri (Martin) but the writer feels that the data on his form is too insufficient to permit even a tentative identification with that species.

Gastrioceras sp.

Plate II, fig. 12

Form subglobose; rather strongly depressed, the ratio of the whorl height to the width being about 1 : 3; whorl section subtrapezoidal; venter widely rounded. Umbilicus measures a little less than  $1/2$  the diameter of the shell, is deep, and the strongly nodose walls are inclined to the dorso-ventral plane at an angle of about 135 degrees; fairly rapid expansion orad; impression  $1/2$ .

The measurements of the specimen (some estimated) are:

|                                |        |
|--------------------------------|--------|
| Diameter (D) est.              | 45 mm. |
| Whorl height (A)               | 11     |
| Whorl width (C)                | 31     |
| Diameter of umbilicus (U) est. | 20     |

The septa are typical gastrioceran, there being nine lobes and saddles. The external sutures consist of a pair of tongue-shaped narrow ventral lobes, and a broader and longer lateral lobe. The saddles are all broadly rounded, and the lobes pointed.

Remarks-. This form is represented by a single fragmental specimen of about  $1/4$  of a whorl. It is too incomplete to permit even a tentative identification, but it apparently does not belong to any previously described species. The whorl section is very similar to that of Gastrioceras montgomeryense (Miller and Gurley), but the writer's specimen is of a larger form and does not show evidence of the constrictions that that species bears.

Gastrioceras cf. subcavum (Miller and Gurley)

Plate II, fig. 13

1896. Goniatites subcavus Miller and Gurley, Bull. Illinois State Mus. Nat. Hist., no. 11, p. 45, pl. 5, figs. 15-17.  
 1903. Gastrioceras subcavum Smith, U. S. Geol. Survey, Mono. 42, p. 97, pl. 17, figs. 15-17.

Shell evolute; whorls depressed; moderately embracing; trapezoidal cross section; sides rounding gently to the angular umbilical shoulders; the angle of the umbilical walls is about 125 degrees, a little steeper than is usual for this species; umbilicus rather large, measuring almost half the diameter of the shell; umbilical shoulders angular and free of nodes; the internal cast is marked by the common Glyptioceratidae constrictions, which occur about four per revolution. Sutures unknown.

Remarks-. The representatives of this form are all fragmental and the identification must be left open to question. All characteristics available, however, point to this identification.

Gastrioceras n.sp.

Plate II, fig. 10

Form subglobose and small; deeply embracing, about  $1/2$  the whorl being impressed by the preceding one; section subtrapezoidal; maximum whorl width attained at the umbilical shoulders and is a little less than twice the whorl height. Umbilicus of moderate size, being almost exactly  $1/3$  the diameter; umbilical shoulders subangular and smooth (at least on the internal cast); umbilical walls straight and steep, being at nearly right angles to the dorso-ventral plane. Each volution is marked by about four constrictions, which are confined to the venter and are slightly sinuous, forming low rounded ventral crests as they bend orad.

The measurements of the specimen is as follows:

|                              |          |
|------------------------------|----------|
| Diameter (D)                 | 18.5 mm. |
| Whorl height (A)             | 6.0      |
| Whorl width at umbilicus (C) | 11.0     |
| Diameter of umbilicus (U)    | 6.0      |

The sutural expression is somewhat obscured but apparently conforms to the usual gastrioceran type. The septa are not closely spaced, the separation being about 5 mm. (measured on the venter) extremely orad where the whorl width is 11 mm.

Remarks-. This form evidently belongs to the group of Gastrioceras globulosum (Meek and Worthen) as indicated by the absence of nodes, and is probably an immature individual, as the constrictions are still present. The septa are more macronate than those of Gastrioceras kansasense (Miller and Gurley) and the umbilical measurements and characteristics do not agree with either Gastrioceras globulosum (Meek and Worthen) or Gastrioceras illinoisense (Miller and Gurley), although somewhat similar to both. It is probably a new species, but the writer does not feel that the data available is sufficient to justify a description of a new species.

Gastrioceras ? sp.

Plate II, fig. 14

This form is represented by a single rather poorly preserved specimen. It may be briefly characterized as follows: Form subdiscoidal, being strongly compressed laterally, the whorl width being but little greater than the whorl height; evolute, the impression being only about  $1/4$ ; umbilicus large, being about



1/2 the diameter of the shell (the illustration of this form shows the umbilicus perforate, but this condition is probably due to an accident of preparation); umbilical shoulders angular, and umbilical walls steep; greatest whorl width attained at umbilical shoulders. Gradual expansion orad. No evidence of nodes. No sutures shown.

The measurements of the specimen are as follows:

|                           |        |
|---------------------------|--------|
| Diameter (D)              | 26 mm. |
| Whorl height (A)          | 6      |
| Whorl width (C)           | 8      |
| Diameter of umbilicus (U) | 13     |
| Impression (I)            | 1.5    |

Remarks-. The preservation of this specimen is such that its identity is very doubtful. The writer believes that it is an immature Gastrioceras buckhornense, n.sp. It is mentioned here as primarily of interest in connection with the triangular nepionic coiling in ammonoids of Croneis (1930) although this phenomenon is generally confined to the genus Paralegoceras. Dr. Croneis has examined the writer's specimen and agrees that it may exhibit the coiling mentioned.

#### Genus Ambiguites, n.g.

Ambiguites, n.g. is established to include forms with gastrioceran sutures, but which are highly compressed laterally, the form being subdiscoidal to discoidal. According to the original author (Hyatt) the genus Gastrioceras includes species with open umbilici and whorls that are semi-lunar or trapezoidal in section, the abdomen being wider than the dorsum, and the lateral walls often costated (but not necessarily so). Some of the species of Gastrioceras, notably the group typified by Gastrioceras compressum Hyatt are compressed laterally, but not beyond the subcircular stage.

Ambiguites, n.g. may be characterized as follows: Form subdiscoidal to discoidal, being strongly compressed laterally; rapid expansion orad, particularly of the whorl height; evolute, a portion of all the older whorls showing in the umbilicus; impression moderate; venter narrow, sharply rounded to subacute; the internal cast, at least, of the later whorls is free of nodes, but the umbilical shoulders of the earlier whorls may bear them; no evidence of constrictions. Sutures of the gastrioceran type, consisting of a rather wide rounded ventral saddle which is succeeded on either side by a rather prominent pointed tongue-shaped ventral lobe, a wide rounded lateral saddle, a large pointed tongue-shaped lateral lobe, and a wide shallow saddle.

There is a shallow pointed lobe on the umbilical seam; internal sutures not known.

The writer regrets that this genus is represented by a single specimen, that of Ambiguites gargantum, n.g., n.sp. as the relationships and phylogeny must remain in doubt until more specimens are recovered and investigated. At present it is regarded as highly significant that this form bears nodes on the umbilical shoulders in the earlier whorls but loses them in the later whorls; Gastrioceras typically bears umbilical nodes, while Paralegoceras usually does not. Ambiguites, n.g. would seem to fill an intermediate position, losing its nodes with maturity. It does not, however, occupy an intermediate position in shape, as it is more discoidal than either Gastrioceras or Paralegoceras. Although the external sutures are similar to those of Gastrioceras, the relationships of the three genera in sutural expression cannot be stated until the internal sutures of Ambiguites are known.

Ambiguites gargantum, n.g., n.sp. is the genotype.

Ambiguites gargantum, n.g., n.sp.

Plate II, figs. 15-17

Form discoidal, being strongly compressed laterally; ratio of whorl height to width about 3 : 2; maximum width attained a little ventrad the umbilical shoulders, the convex lateral walls converging toward the sharply rounded venter (most of the venter of the holotype is sharply angular, but this is due to crushing); evolute, a portion of all the older whorls showing in the umbilicus, which has a diameter equal to about 1/4 that of the shell; umbilical shoulders rounded, not abrupt; umbilical walls steep, nearly vertical to the dorso-ventral plane. Rapid expansion orad, particularly of the whorl height; impression moderate, being about 1/3. The type consists of at least four volutions.

The measurements of the type specimen are:

|                            |         |
|----------------------------|---------|
| Diameter (D)               | 285 mm. |
| Whorl height (A)           | 119     |
| Maximum whorl width (at C) | 80      |
| Diameter of umbilicus (U)  | 69      |
| Depth of umbilicus (L)     | 35      |
| Impression (I)             | 40 (?)  |

The surface of the shell is not preserved but much of the inner shell is. This indicates that the surface was marked by wide, simple, sinuous, almost directly transverse growth lines. Longitudinal markings were either not present or were too faint to show on the inner shell. The mature portion of the inner cast at least is free of nodes, but the umbilical shoulders of the very

earliest whorls are marked by blunt conoidal nodes. Unfortunately, the first whorls are slightly obscured, but the last two and a half volutions of the type are free of nodes.

The septa are of the gastrioceran type, consisting of a rounded ventral saddle, this followed on either side by a pointed tongue-shaped ventral lobe, rounded deep lateral saddle, large pointed tongue-shaped lateral lobe, and shallow rounded lateral saddle. The second lateral lobe is present on the umbilical seam, and is low and bluntly pointed. Internal sutures not known.

Remarks--. So far as the maximum diameter is concerned this is one of the largest known species of Carboniferous ammonoids, the holotype measuring 11 1/2 inches across. A very small part of this measurement is thought due to crushing, but as the expansion is very rapid and the specimen entirely septate, the complete shell was probably much larger.

#### Genus Paralegoceras Hyatt 1883

For the generic diagnosis of this common Carboniferous form the reader is referred to Hyatt's (1883, p.327) original description.

#### Paralegoceras discus, n.sp.

Plate II, figs. 18-21

Form subdiscoidal, being strongly compressed laterally; the maximum whorl width (C) is a little more than 1/2 the whorl height (A); walls subparallel, the maximum whorl width being attained slightly ventrad the umbilical shoulders and the walls converging slightly toward the broadly rounded venter; rapid expansion orad, particularly of the whorl height; impression about 1/2. Umbilicus small, being less than 1/5 the diameter of the shell, deep, the shoulders abruptly rounded, and the walls almost vertical to the ventro-dorsal plane. No evidence of nodes.

The measurements of the holotype are as follows:

|                                |         |
|--------------------------------|---------|
| Diameter (D)                   | 125 mm. |
| Whorl height (A)               | 61      |
| Whorl width near umbilicus (C) | 37      |
| Diameter of umbilicus (U)      | 24      |

The type specimen does not preserve any of the original shell, but a fragmental specimen of the same species displays well the surface markings. The growth lines are rather fine and regular, sinuous, and almost directly transverse; these growth lines are crossed by straight longitudinal lirae of about the same size and spacing, giving the surface a reticulate appearance. Where a longitudinal lirae crosses a transverse growth line a fine node is



formed. Near the umbilicus the transverse growth lines are slightly stronger than the longitudinal ones, but near the venter the reverse is true.

The septa conform to the usual Paralegoceras pattern and are rather crowded; the ventral saddle and lobes are somewhat more prominent than is usual for this genus. The external lobes are all pointed and only moderately narrow, and the external saddles are all rounded tongue-shaped. Eleven lobes and saddles in all.

Remarks-. In whorl section this species bears a rather close resemblance to Paralegoceras iowense (Meek and Worthen) from the middle Coal Measures of Iowa but can be distinguished from that form by a more rapid whorl expansion, smaller umbilicus, and more prominent saddle. In addition, the lobe which is usually present on the umbilical seam has evidently migrated ventrad and appears on the umbilical wall as a low weak lobe in this species.

#### Family (uncertain)

#### Genus Walkerites, n.g.

The genus Walkerites, n.g. is established to include discoidal ammonoids with rather high, thin whorls. The sutural expression is unusual; there are twenty-one lobes and saddles (the divided ventral lobe is considered as two lobes and one saddle for convenience). Sixteen lobes are external and the remaining five internal. The lobes are pointed tongue-shaped to lanceolate, and the saddles are rounded tongue-shaped. The outstanding generic characteristic is the eccentric second lateral lobe which is about half again as long as the next longest lobe.

Walkerites vulgaris, n.sp. is the genotype.

#### Walkerites vulgaris, n.g., n.sp.

Plate II, figs. 24,25

Discoidal; rather large size; highly compressed laterally, the ratio of the whorl height (A) to the width (C) being about 2 : 1; maximum whorl width attained just ventrad the umbilical shoulders; lateral walls slightly convex, almost straight, and convergent toward the narrowly rounded or subacute venter; impression a little less than  $1/2$ ; rapid expansion orad, particularly of the whorl height; evolute, a portion of all the older whorls showing in the umbilicus (the type consists of about five volutions) with the umbilicus fairly large, measuring about  $1/3$  the diameter of the shell, umbilical shoulders sharply rounded, and the umbilical walls at nearly right angles to the dorso-ventral plane.

There is a moderate size range; the type specimen is of average size and its measurements are as follows:

|                           |         |
|---------------------------|---------|
| Diameter (D)              | 130 mm. |
| Whorl height (A)          | 57      |
| Whorl width (C)           | 27      |
| Diameter of umbilicus (U) | 40      |
| Depth of umbilicus (L)    | 13      |

Both the surface of the shell and the internal cast are free of nodes, carinae, or constrictions. The only noteworthy sculpture, other than the growth lines, is a longitudinal groove on each flank about  $1/3$  of the distance from the venter to the umbilicus. The surface of the shell is beautifully marked by fine growth lines which form a rather deep hyponomic sinus, and, in order, a marked lateral crest, rounded lateral sinus, and a shallow lateral crest. Where the growth lines cross the venter they thicken to form rather marked lirae.

The septal expression is of the Walkerites type of 21 lobes and saddles, with the long eccentric second lateral lobe the outstanding feature. The lobes are all pointed tongue-shaped to lanceolate, and the saddles are rounded tongue-shaped. Sixteen of the lobes are external and the remaining five internal.

Remarks-. This species is well represented by a large number of specimens, and with Walkerites plummeri, n.sp. makes up by far the greatest part of the ammonoids of the deposit. This species is distinguished from Walkerites plummeri, n.sp. by being less discoidal and having a larger umbilicus than that species. Plummer (personal communication) has described a somewhat similar form from the Mississippian (?) of west Texas under the name of Wellerites mohri in his monograph which will soon be published. His form is congeneric with the writer's species but they are different species. Walkerites vulgaris, n.sp. differs from Wellerites mohri in being larger, less discoidal, and a decidedly larger first lateral saddle and lobe.

Walkerites plummeri, n.g., n.sp.

Plate II, figs. 22,23

Form discoidal; moderate size; whorl section thin and high; the ratio of the whorl height to the maximum width being almost 3 : 1; greatest whorl width attained just ventrad the umbilical shoulders; lateral walls almost straight and convergent toward the angular venter; impression about  $1/3$ ; rather rapid expansion orad, particularly of the whorl height. Evolute, a portion of each of the preceding whorls showing in the umbilicus, which is small, measuring less than  $1/4$  the diameter of the shell; umbilical shoulders sharply rounded, with the umbilical walls nearly vertical to the dorso-ventral plane.

The measurements of the holotype are as follows:

|                           |        |
|---------------------------|--------|
| Diameter (D)              | 67 mm. |
| Whorl height (A)          | 29     |
| Maximum whorl width (C)   | 10     |
| Diameter of umbilicus (U) | 15     |
| Umbilical depth (L)       | 3      |
| Impression (I)            | 9      |

Both the surface of the internal cast and of the shell are free of nodes and constrictions; the surface is, however, marked by two longitudinal grooves on each lateral wall. The first groove is about  $1/3$  the distance from the venter toward the umbilical shoulder, and the second is about  $1/2$  the distance from the venter toward the umbilical shoulder. The surface of the shell is beautifully marked by fine growth lines which form a rather deep hyponomic sinus, and, in order on either side, a marked lateral crest, rounded lateral sinus, and shallow lateral crest. Where the growth lines cross the venter the thicken to form rather marked lirae. The ventrad portion of the lateral walls, that is, from the venter to the first longitudinal groove, is further marked by rather low longitudinal lirae which are not closely spaced; the most ventrad pair (on each side) are more pronounced than the others.

The sutures are of the usual Walkerites pattern, that is, twenty-one lobes and saddles, with the long eccentric second lateral lobe the outstanding characteristic. The lobes are all sharply pointed and lanceolate to tongue-shaped, and the saddles are all rounded tongue-shaped. Sixteen of the lobes are external and the remaining five internal.

Remarks-. This species is distinguished from the genotype Walkerites vulgaris, n.g., n.sp. by being more discoidal, smaller, having a smaller umbilicus, and having the ventral longitudinal lirae. It differs from Wellerites mohri in being larger, slightly more discoidal, and in having a larger first lateral lobe and saddle than that species.



## EXPLANATION OF PLATE I

- Figs. 1-3. Orthoceras unicamera, n.sp. p. 7.  
 1. Lateral view of holotype. (x 2)  
 2. Cross section of another specimen. (x 2)  
 3. A specimen with wall removed to show external appearance of siphuncle. (x 2)
- Figs. 4-6. Orthoceras gracile, n.sp. p. 8.  
 4. Lateral view of holotype. (x 2)  
 5. Cross section of another specimen. (x 2)  
 6. Thin section of apical extremity. (x 4)
- Fig. 7. Orthoceras indianum var. buckhornense, n.var. p. 9.  
 Lateral view of type showing fine growth lines. (x 2)  
 Note where wavy growth lines show repaired injury.
- Figs. 8,9. Orthoceras tricamerae, n.sp. p. 9.  
 Lateral view of holotype and cross section of another specimen. (both x 2)
- Figs. 10-12. Pseudorthoceras knoxense (McChesney) p. 5.  
 10. Lateral view of a well preserved specimen showing the false siphuncle. (x 1/2)  
 11. Thin section of a somewhat larger specimen. (x 1/2)  
 12. Portion of another specimen showing original shell surface. (slightly larger than x 1)
- Figs. 13-14. Dolorthoceras n.sp. p. 6.  
 Lateral view and a cross section of a camera from the same specimen. (x 1/2)
- Figs. 15-16. Dolorthoceras oklahomense, n.sp. p. 6.  
 Lateral view of holotype, and cross section. (x 1/2)
- Fig. 17. Ephippioceras ferratum (Cox) (x 1/2) p. 10.
- Figs. 18-20. Temnocheilus milleri, n.sp. p. 11.  
 Lateral and ventral views of holotype and diagrammatic cross section of whorl. (x 1/4)
- Figs. 21,22. Metacoceras sp. p. 12.  
 Lateral view and diagrammatic cross section. (x 1/2)
- Figs. 23-25. Domatoceras robustum, n.sp. p. 13.  
 23. Internal cast of the holotype. (x 1/4)  
 24. Mold and portion of shell wall of holotype. (x 1/4)  
 25. Diagrammatic cross section.
- Figs. 26,27. Domatoceras buckhornense, n.sp. p. 14.  
 Lateral view of holotype (x 1/4) and diagrammatic cross section.

- Figs. 28-30. Domatoceras angularum, n.sp. p. 16.  
 28. Lateral view of holotype. (x 1/2)  
 29. Diagramatic cross section extreme orad.  
 30. Diagramatic cross section apicad.
- Figs. 31,32. Domatoceras angularum var. modestum, n.sp. p. 17.  
 Lateral view of holotype (x 1/2) and diagramatic  
 cross section of extreme orad portion.
- Figs. 33,35. Domatoceras parallelum, n.sp. p. 15.  
 Lateral and ventral views of holotype (x 1/2) and  
 diagramatic cross section orad.
- Figs. 36,37. Domatoceras sp. p. 18.  
 Lateral view (x 1/4) and diagramatic cross section.
- Figs. 38-40. Pseudometacoceras ? sp. p. 19.  
 38. Lateral view. (x 1/2)  
 39. Diagramatic cross section orad.  
 40. Diagramatic cross section apicad.
- Fig. 41. Solenochilus ? sp. (x 1/2) p. 20.

## PLATE I

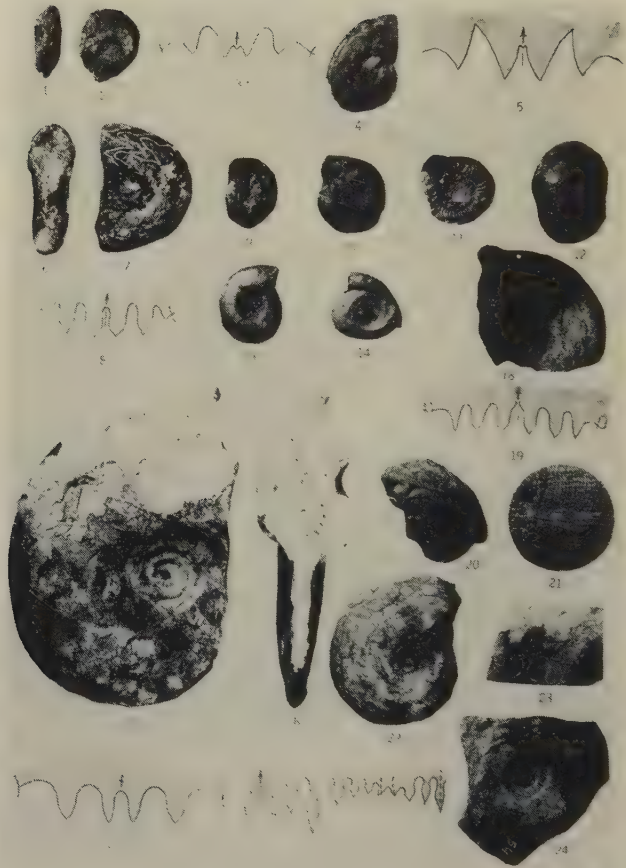




## EXPLANATION OF PLATE II

- Figs. 1-3. Milleroceras parrishi (Miller and Gurley) p. 21.  
Ventral and lateral views (x 1) and sutures.
- Figs. 4,5. Gonioloboceras bicanaliculatum, n.sp. p. 23.  
Lateral view of holotype (x 1/4) and sutures.
- Figs. 6-8. Gastrioceras buckhornense, n.sp. p. 24.  
Sectional and lateral view of holotype (x 1/4) and sutures.
- Fig. 9. Gastrioceras kansasense (Miller and Gurley)? p. 25.  
Lateral view. (x 1)
- Fig. 10. Gastrioceras n.sp. (x 1) p. 27.
- Fig. 11. Gastrioceras sp. (x 1) p. 25.
- Fig. 12. Gastrioceras sp. (x 1/2) p. 26.
- Fig. 13. Gastrioceras cf. subcavum (Miller and Gurley) p. 26.  
Lateral view of fragmental specimen. (x 1/2)
- Fig. 14. Gastrioceras ? sp. p. 27.  
Immature form (Gastrioceras buckhornense, n.sp.?) showing triangular nepionic coiling. (x 1/2)
- Figs. 15-17. Ambiguites gargantum, n.g., n.sp. p. 29.  
15. Lateral view of holotype showing the noded character of the earlier whorls; later whorls smooth.  
16. Ventral view of same. (x 1/4)  
17. Sutures.
- Figs. 18-21. Paralegoceras discus, n.sp. p. 30.  
18. Lateral view of holotype. (x 1/4)  
19. Sutures.  
20. Fragmental specimen showing sutures. (x 1/4)  
21. Enlargement of shell surface of another specimen.
- Figs. 22,23. Walkerites plummeri, n.g., n.sp. p. 32.  
22. Lateral view of holotype; note lateral grooves. (x 1/2)  
23. Fragmental specimen showing sutures. (x 1/2)
- Figs. 24,25. Walkerites vulgaris, n.g., n.sp. p. 31.  
Lateral view of holotype (x 1/4) and sutures.

PLATE II



# BIBLIOGRAPHY

Cronels, Carey

- 1930. "Triangular nepionic coiling in Carboniferous ammonoids:" Science, new ser., vol. 72, no. 1873, pp. 534-535.

Eldridge, George H.

- 1901. "Report on the asphalt bearing rocks:" U. S. Geol. Survey, 22nd Ann. Rpt., pt. 1.

Girty, George H.

- 1908. "The Guadalupian Fauna,"; U. S. Geol. Survey, P. P. 58.
- 1909. "Fauna of the Caney shale of Oklahoma,"; U. S. Geol. Survey, Bull. 377.
- 1911. "On some new genera and species of Pennsylvanian fossils from the Wewoka formation of Oklahoma,"; New York Acad. Sci. Annals, vol. 21, pp. 119-155.
- 1915. "The fauna of the Wewoka formation of Oklahoma,"; U. S. Geological Survey, Bull. 544.

Hyatt, Alpheus

- 1867. "The fossil cephalopods of the Museum of Comparative Zoology,"; Bull. 1, pp. 71-102.
- 1883. "Genera of fossil cephalopods,"; Boston Soc. Nat. Hist. Proc., vol. 22, pp. 253-338.
- 1891. "Carboniferous cephalopods,"; Texas Geol. Survey Ann. Rpt. 2, pp. 327-356.
- 1893. "Carboniferous cephalopods,"; (second paper); Texas Geol. Survey Ann. Rpt. 4, pp. 377-474.
- 1894. "Phylogeny of an acquired characteristic,"; Am. Phil. Soc. Proc., vol. 32, pp. 349-647.
- 1900. "Tetrabranchiate Cephalopods,"; Zittel-Eastman Text-book of Paleontology, vol. 1, pp. 502-592, London and New York, Macmillan and Co.

Miller, A. K.

- 1930. "A new ammonoid fauna of late Paleozoic age from western Texas,"; Jour. Paleontology, vol. 4, no. 4, pp. 383-412, pls. 38,39.
- 1931. "Two new genera of late Paleozoic cephalopods from central Asia,"; Amer. Jour. Sci., 5th ser., vol. 22, pp. 417-425.
- 1932. "A Pennsylvanian cephalopod fauna from south-central New Mexico,"; Jour. Paleontology, vol. 6, no. 1, pp. 59-93, pls. 12,13.



- Miller, A. K., Dunbar, Carl O., and Condra, G. E.  
 1933. "The nautiloid cephalopods of the Pennsylvanian system of the mid-continent region,"; Nebraska Geol. Survey, 2nd ser., Bull. 9.
- Moore, Raymond C., and Plummer, Frederick B.  
 1922. "Stratigraphy of the Pennsylvanian formations of north-central Texas,"; Univ. Texas Bull. 2132 (1921).
- Morgan, George D.  
 1924. "Geology of the Stonewall quadrangle, Oklahoma,"; (Oklahoma) Bureau of Geology, Bull. 2.
- Schindewolf, O. H.  
 1933. "Vergleichende Morphologie und Phylogenie der Anfangskammern tetrabranchiater Cephalopoden,"; Preuss. Geol. Landesanstalt Abh., Neue Folge, Heft 148, pp. 1-115.
- Smith, J. Perrin  
 1903. "The Carboniferous ammonoids of America,"; U. S. Geol. Survey, Mono. 42.
- Taff, J. A.  
 1903. "Tishomingo Folio, Indian Territory,"; U. S. Geol. Survey.
- Teichert, Curt  
 1928. "Über *Orthoceras regulare* Schloth. und verwandte Formen,"; Sonderabdruck aus Zeitschrift für Geschiebeforschung, Bd. IV, Heft 3.
- Troedsson, Gustaf T.  
 1931. "Studies in the Baltic fossil cephalopods: 1. On the nautiloid genus *Orthoceras*,"; Lunds Universitets Årsskrift N. F. Avd. 2, Bd. 27, Nr. 16, Kungl. Fysiografiska Sällskapets Handlingar, N. F., Bd. 42, Nr. 16.
- Yin, T. H.  
 1933. "Cephalopods of the Penchi and Taiyuan series of north China,"; Paleontologica Sinica, ser. B, vol. 11, fascicle 3, pp. 1-46, pls. 1-5.





